

## New and little known taxa of Rhytidochrotinae (Acrididae, Orthoptera) from Costa Rica

C. Hugh F. ROWELL

Zoologisches Institut, Universität Basel,  
Rheinsprung 9, CH-4051 Basel, Switzerland.

**New and little known taxa of Rhytidochrotinae (Acrididae, Orthoptera) from Costa Rica.** - Three new monospecific genera are described from montane areas of Costa Rica. Like the other three known Costa Rican rhytidochrotine genera (*Hylopedetes* Rehn, 1929, *Scirtopaon* Descamps & Rowell, 1984 and *Micropaon* Descamps & Rowell, 1984) they belong to the atympanate and apterous division of the subfamily. All are apparently confined to small geographical areas. *Exerythracris volcanica* n.sp. is a fern eater from the light gaps and edges of montane forest, and resembles in gross morphology the similarly specialised *Hylopedetes*. It is the most northerly representative of the subfamily so far described, extending almost to the Costa Rican/Nicaraguan border. *Brakeracris varablancensis* n.sp. is found in successional areas (landslips, anthropogenically altered habitats) in montane forest; its diet is unknown, but does not apparently include ferns; morphologically it is closest to *Scirtopaon*. *Talamancacris palustris* n.sp. is confined to a few relict subalpine swamps and appears to eat Asteraceae preferentially; it is not obviously closely allied to the other genera. Additionally, new morphological, ecological and biogeographic data are given for the three previously described genera.

**Key-words:** Orthoptera - Acrididae - Rhytidochrotinae - Costa Rica - Taxonomy.

### INTRODUCTION

Last globally reviewed by DESCAMPS & AMÉDÉGNATO (1972b), the group Rhytidochrotinae was elevated to subfamily status by AMÉDÉGNATO (1975). It currently includes 17 genera and 35 species (DESCAMPS & AMÉDÉGNATO 1972b; DESCAMPS & ROWELL 1978; DESCAMPS & ROWELL 1984), to date known only from the northern half of South America and from the southern part of Central America

(i.e., from Brasil to Costa Rica). The greatest number of genera and species is found in Colombia. With few exceptions (*Paropaon*, *Piezops*, *Lathacris*, *Hylopedetes mirandus*) the Rhytidochrotines are insects of montane forest (roughly 1000 m to 2500 m in altitude) and are patchily distributed. Some genera are behaviourally specialised to eat ferns (ROWELL *et al.* 1984). They are often brilliantly coloured, especially the males, sometimes in unusual shades of red.

The formal morphological characteristics of the subfamily were listed by DESCAMPS & AMÉDÉGNATO (1972b) and AMÉDÉGNATO (1977). All genera but one (*Driphilacris* Descamps & Amédégnato, 1972a) are completely apterous, and about half of them are also atympanate. The pronotum is characteristically short, exposing the entire meso- and metanota, and traversed dorsally by three sulci; the first of these is short with ends curved anteriorly, almost joining a further groove running just behind margin of pronotum, which is obsolete dorsally (*Lathacris* Descamps & Amédégnato, 1972a has only 2 transverse sulci). Males have a "furcula" (a notched and usually toothed posterior margin of the 10th abdominal tergite). Similar pronota and furculae are however seen in several Ommatolampine genera, e.g. *Tannacris* Descamps & Amédégnato, 1972a. The male genitalia are characteristic and homogenous; the aedeagus is extremely short and completely sheathed, with very reduced inferior sclerites and very short superior ones. The only part of the male genitalia that is at all useful in distinguishing genera is the epiphallus (especially the shape and orientation of the lophi). The ventral ovipositor valves are typically slender distally and along their dorsal edge and lie largely between the dorsal valves. In the Central American genera both lower and upper valves are prominently toothed on their outer edges, though this is denied in previous characterisations of the subfamily. In all the genera I have examined Collins' tooth (COLLINS, 1991) is present on anterior margin of the third antennal segment from distal end.

The first rhytidochrotine genera described from Central America were *Piezops* Hebard, 1923 from southern Panama and *Hylopedetes* Rehn, 1929 from central Costa Rica. *Hylopedetes* originally included three species; DESCAMPS & ROWELL (1978) described 2 additional species, bringing the total to 5. *Scirtopaon* and *Micropaon*, also from Costa Rica, were added by DESCAMPS & ROWELL (1984). The present article describes three new genera from the uplands of Costa Rica, and provides additional morphological drawings and new localities for the previously described genera and species. A new artificial key to the atympanate genera of the Rhytidochrotinae (all the known Costa Rican taxa fall into this category) is provided. For the remaining (tympanate) genera the corresponding section of the key given by DESCAMPS & AMÉDÉGNATO (1972b) remains valid.

## MATERIALS AND METHODS

In addition to the new taxa described, I had access while preparing this paper to material of the the following Rhytidochrotine genera: *Galidacris*; *Hylopedetes*; *Micropaon*; *Opaonella*; *Parapiezops*; *Paropaon*; *Piezops*; *Rhytidochrota*; *Scirtopaon*; *Trichopaon*. The other genera are known to me only from the literature.

Dimensions were measured with a graticule eyepiece at a total magnification of X25 (Wild M5 stereomicroscope) in conjunction with a moving stage fitted with a digital micrometer (Mitutoyo) reading to 0.01 mm. Measurements were repeatable to within 0.02 mm. The length of the pronotum was measured in the midline; as the posterior and anterior margins of the pronotum are mostly notched in midline in the Rhytidochrotinae, the measurements are from the bottom of these notches. Overall length is from the most anterior part of the frontal ridge to the posterior end of the subgenital plate (males) or the extremities of the ovipositor valves (females). The size of the rostrum is expressed as the ratio of the two distances illustrated in Fig. 1.

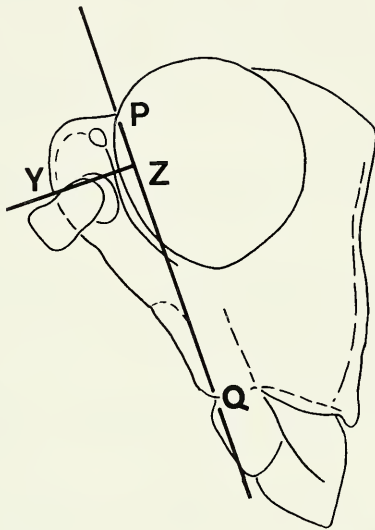


FIG. 1

Derivation of the rostrum index used in the text and Table 4. On a drawing of a side view of the head (here of *Hylopedetes mirandus*) a line is drawn from P, the junction of the outline of the compound eye and the upper surface of the fastigium, to Q, the notch of the frontoclypeal suture. A further line YZ is then drawn normal to PQ, passing through the furthest extremity of the rostrum, Y. The rostrum index is the ratio  $YZ/PQ$ .

Drawings of the male internal genitalia were made with a drawing tube fitted to a Leitz compound microscope, and of other parts via tracings from projected colour transparencies photographed with a Wild Photomicroscope.

Abbreviations of museums: ANSP, Academy of Natural Sciences, Philadelphia; INBio, Instituto Nacional de Biodiversidad, Santo Domingo de Heredia, Costa Rica; MNHN, Muséum National d'Histoire Naturelle, Paris; RC, the author's collection, University of Basel.

## KEY TO THE ATYMPANATE GENERA OF THE RHYTIDOCROTINAE (Males only)

- 1 6 external spines on hind tibia (S. America).  
 ..... *Lathacris* Descamps & Amédégnato, 1972a
- 7 external spines on hind tibia. .... 2
- 2 Supraanal plate without black spots. .... 3
- Supraanal plate with black spots. .... 8
- 3 Interocular space more than 3X wider than frontal ridge (S. America).  
 ..... *Muyscacris* Hebard, 1923
- Interocular space less than 3X wider than frontal ridge. .... 4
- 4 Medial carina of pronotum at least partially present. .... 5
- Medial carina of pronotum absent. .... 6
- 5 Medial carina thin but entire, cut by sulci (Fig. 9B).  
 ..... *Scirtopaon* Descamps & Rowell, 1984
- Medial carina of pronotum present only in front of 1st sulcus and behind 3rd sulcus (Fig. 4C). .... *Brakeracris* n. gen.
- 6 Dorsal apical spine of hind knee longer than outer knee lobe (Fig. 6G).  
 Paired tufts of sparse white hairs dorsolaterally on abdominal and thoracic segments. .... *Talamancacris* n. gen.
- Dorsal apical spine of hind knee equal to or shorter than outer knee lobe. ... 7
- 7 Meso- and metanota smooth, "epaulettes" (see p. 7) obsolete, anterior pronotal sulcus shallow (Figs. 8A & B); knee spine much shorter than outer knee lobe (Fig. 8D). .... *Hylopedetes* Rehn, 1929
- Meso- and metanota heavily pitted, "epaulettes" present, anterior pronotal sulcus deep and well marked (Figs. 2B & C). Dorsal apical spine of hind knee as long as outer lobe (Fig. 2G). .... *Exerythracris* n. gen.
- 8 Frontal ridge extends to clypeus. Face flat. Medial carina of pronotum present, cut by only 2 sulci. Supraanal plate with 2 black spots (S. America). .... *Lathacris* Descamps & Amédégnato, 1972a
- Frontal ridge absent below medial ocellus. Face concave. Medial carina of pronotum absent or very indistinct. .... 9
- 9 Supranal plate with 2 black spots. Points of furcula long and sharp (S. America). .... *Paropaon* Hebard, 1923
- Supranal plate with 1 medial black spot. Points of furcula short and blunt. Posterior margins of meso- and metanota thickened and raised in midline. .... *Micropaon* Descamps & Rowell, 1984

## DESCRIPTIONS OF NEW TAXA

**Exerythracris** n. gen.

Type species: *Exerythracris volcanica* n. sp.

*Male.* (Figs. 2 & 3). Size small-medium (10mm<body length<20 mm). General form cylindrical, slender, long legged. Integument polished; dorsal surfaces of thorax, occiput, hind femora, and to a lesser extent of abdomen, heavily pitted.

Fastigium steeply inclined forwards, tapering, bearing a pair of low longitudinal ridges proximally, distally shallowly grooved medially, the groove not reaching the anterior margin of the fastigium (Fig. 2B, D). Frontal ridge narrow, not wider than interocular space, narrow at top and bottom, slightly wider opposite the upper margin of the antennal foramen, ending and diverging slightly above the very small medial ocellus (Fig. 2E). Profile of frons markedly concave, the frontal ridge forming a rounded rostrum, index 0.33 (Fig. 2B). Subantennal sutures thin and rather indistinct, the ventral sutures short and projecting laterally; ventral margin of frons at frontoclypeal suture distinctly concave (Fig. 2E). Preocular ridges of frons present. Eyes large and globose; interocular space narrow, 0.6 - 0.8X as wide as greatest width of antennal scape. Antennae long, filiform, slender, round in cross section, 17 segments in flagellum of adult, end of terminal segment obliquely pointed.

Prothorax (Fig. 2B,C) without medial carina. Transverse sulci deep. Dorso-lateral area between 2nd and 3rd sulci inflated into a prominent bulge, bearing a matte-surfaced oval depression (this structure is characteristic of many rhytidochrotine genera, and is here referred to as an "epaulette" - see also the description of *Loepacris*, DESCAMPS & AMÉDÉGNATO 1972b: 1068 & their Fig. 20). Posterior ventral angle of lateral lobe of pronotum rounded, posterior margin above the ventral angle straight. Anterior ventral angle of lateral lobe of pronotum obtusely rounded. Both anterior and posterior margins of pronotum slightly notched in midline. Prosternal process short, abruptly conical, vertical or slightly angled forwards. Apterous. Posterior margins of meso- and metanotum somewhat raised, giving a saw-tooth dorsal profile to thorax in lateral view.

Hind femora very long (4.3X as long as pronotum) and slender; outer face of femur rounded. Dorsal carina of femur terminating in a short spine, which equals but does not exceed the external upper lobe of the knee (Fig. 2G). Seven non-terminal spines on the dorsal external margin of hind tibia, 8 on the dorsal internal. Hind tarsi long, 0.34X as long as hind femur and 1.45X as long as pronotum. Third tarsal segment 1.5X as long as the first and second segments together. Claws long and widely separated.

Tympanum absent. Posterior margin of 10th abdominal tergite with a central notch and short lateral sclerotised teeth (Fig. 2F). Supraanal plate triangular, without sclerotised melanic markings, slightly rounded at apex and with a slight medial furrow at its base (Fig. 2F). Cerci short, conical, simple. Subgenital plate smoothly rounded, in dorsal view terminating in a short medial furrow. Internal genitalia (Fig. 3) of the type typical for the subfamily.

*Female.* Size, medium (20mm<body length<30 mm), 1.3-1.4X as long as the male. Differs from male as follows:

Integument less polished, more extensively pitted than in male. Interocular space slightly wider than in male, 0.9X as wide as antennal pedicel. Antennae slightly flattened dorsoventrally and relatively shorter than in male (3.1X pronotum).

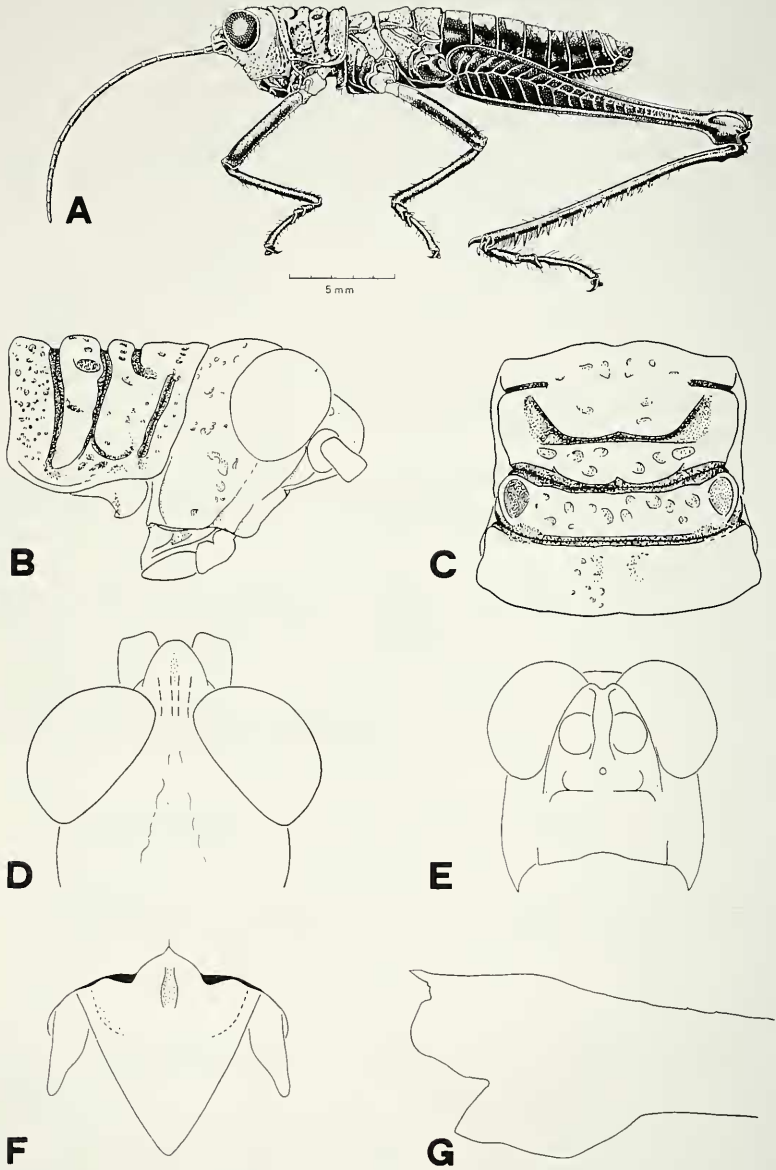


FIG. 2

*Exerythracris volcanica* n.sp. Male. A. Lateral view of entire insect. B. Lateral view of head and pronotum. C. Dorsal view of pronotum. D. Dorsal view of head. E. Frontal view of face. F. Dorsal view of furcula, supraanal plate and cerci. G. Lateral view of hind knee.

Fusiform in shape, posterior margin of pronotum, meso and metathorax, and the anterior segments of abdomen being relatively wider than in male. Pronotum with the merest suggestion of a median carina, defined more by local absence of pitting than by a raised ridge. Hind tarsus and femur relatively shorter than in male, the femur 3.9X as long as pronotum. Third segment of hind tarsus 1.4X length of 1st and 2nd segments together. Genitalia (Fig. 3H-K) typical for the subfamily. Spermatheca not examined.

*Diagnosis.* The dimensional comparison with other taxa is shown in Table 4. *Exerythracris* has one of the proportionately longest hind femora (4.3X pronotum) and both the longest last tarsal segment (approx. 1.5X the 1st & 2nd segments together) and the longest rostrum (index 0.33) of all the genera examined. The genus is superficially similar to *Hylopedetes* Rehn (Fig. 8) and shares with it the very elongate third tarsal segment. It differs from *Hylopedetes* in numerous details: lophi of epiphallus not convergent towards the midline as in all species of *Hylopedetes* (Fig. 8G); proportionately longer and more slender legs and antennae; more pronounced rostrum (index 0.28 in *H. mirandus*); deep anterior pronotal sulcus (rather weak in *Hylopedetes* (Fig. 8A)); presence of well developed "epaulettes" between 2nd and 3rd sulci (barely discernible in *Hylopedetes*, Fig. 8B); anterior ventral angle of pronotum obtusely rounded, and not with a ventrally directed projection as in *Hylopedetes* (Fig. 8A); relatively well developed dorsal spine on hind knee (minute in *Hylopedetes* (Fig. 8F)); furcula with relatively shorter teeth than in *Hylopedetes* (Fig. 8E).

*Etymology:* *Exerythros*, "very red", referring to the coloration of the type species; *acris*, conventionally used for "grasshopper".

### ***Exerythracris volcanica* n. sp.**

Holotype ♂: COSTA RICA, Prov. Guanacaste: P.N. Guanacaste: Volcán Cacao, 1300 m, map ref. N323300, E375300, (H.E. Braker), 31 July 1987, specimen no. RC 87020. Allotype ♀: COSTA RICA, Prov. Guanacaste: P.N. Guanacaste: SW slope of Volcán Cacao, 1040 m, map ref. N323300, E375300, (C.H.F. Rowell, N. Elsner, C. Chavez), 24 July 1991, specimen no. RC 91184. Both in ANSP. Paratypes: COSTA RICA: 5 ♂♂ (specimen no.s 87016, 87017, 87018, 87019, 87021), data as holotype, RC. 1 ♂ (specimen no. 91183), data as allotype, RC. 1 ♀ (specimen no. 87022), data as holotype. 1 ♂ (specimen no. CRI001 013209), same locality, but 11 July, 1988 (D. Janzen & W. Hallwachs), INBio. 3 ♂♂ (specimen no.s CRI001 013226, CRI001 013227, CRI001 013229), same data, but 15 Feb 1989 (GNP Biodiversity Survey), INBio. 1 ♀ (specimen no. CRI000 384037), same locality, but 1 Mar 1989 (PNG Inventario de Biodiversidad), INBio. 1 ♂ (specimen no. CRI000 283607), same locality, but 15 June 1990 (II. curso parataxónomo INBio), INBio. 2 ♂♂ (specimen no.s 91124, 91125), Prov. Guanacaste, Volcán Tenorio, nr. summit of road from Tierras Morenas to Bajo Los Cartagos, 1040 m., map ref. N287250 E426500, 21 July 1991 (C.H.F. Rowell & N. Elsner), RC. 1 ♀ (specimen no. 80237), Prov. Alajuela, nr. Monteverde, Peñas Blancas, Vargas' pasture, edge of Elfin Forest, 1320-1370 m, map ref. N253300 E450500, 16 July 1980 (C.H.F. Rowell, M. Rowell-Rahier, C. Hyde, H.E. Braker), RC.

*Male.* The live male is bright red with shining jet-black eyes, legs, antennae and underside. In pinned specimens (described below) the colours become more dilute.

Antennae, blackish purple. Eyes beige to brown. Labrum and mandibles, dark purple. Palps green, suffused with black. Rest of head carmine red. Pro-, meso- and metanota, thoracic episterna and epimera, carmine red. Sulci blackish. First 6 abdominal tergites with a medial carmine spot, decreasing in size on the more posterior segments. Abdomen and thorax otherwise purplish black. All legs and feet purplish black. Coxa, trochanter, and basal part of femur of fore and mid legs yellowish green, especially on ventral surfaces. Spines of hind tibia greenish yellow tipped with black.

Internal genitalia: epiphallus sharply constricted and ventrally depressed in midline, bearing large conical sclerotized lophi, relatively widely spaced, the inner faces of which are slightly divergent in axial view (Fig. 3A). Lateral epiphallic sclerites present. Cingulum robust, almost completely enveloping the aedeagus (Fig. 3D, F). Aedeagus very short, upturned, sheathed; the inferior sclerites joined to the rest of the endophallus by a narrow, almost vertical flexure (Fig. 3E). Anterior apodemes of the endophallus flattened dorsoventrally, horizontal and markedly divergent (Fig. 3G).

Female. In life the general olive brown coloration is marbled with yellow, the band across the frons, genae and pronotal lobes is bright cream, abdominal segments are green laterally. Distal abdominal segments (5th onwards) are also green dorsally. Basal segments of all legs are green; the black hind femur has a greenish cast. Antennae dark brown. In pinned specimens (described below) the colours change.

Antennae purplish black. Eyes brown. Head olive brown, a paler stripe extending across genae and frons and continuing posteriorly on the lobes of the pronotum. Labrum and mandibles blackish purple. Palps green. Pronotum generally olive brown; anterior and posterior margins and anterior ventral part of lateral lobes olive green. Thorax and abdomen olive brown, tinged green on sides of abdominal segments 2-5. Ovipositor valves purplish brown.

Fore leg: as in male. Mid leg: coxa, trochanter, basal part of femur light brown; distal femur black; tibia greenish proximally, purplish distally; tarsus purple. Hind leg: femur olive brown dorsally, inner and outer faces black; knee, tibia and tarsus purple; spines of tarsus green tipped with black. Claws black.

Ovipositor valves long, extending 1.26 mm beyond end of supraanal plate (Fig. 3J). Lower ovipositor valves with a proximal shoulder on outer lateral face (Fig. 3I, J), laterally compressed, normally held between the dorsal valves (Fig. 3K). Both upper and lower ovipositor valves toothed on outer margins, inner faces bearing numerous long hair sensilla. Subgenital plate with concave posterior margins and a simple central apex (Fig. 3H).

(The single adult female from Peñas Blancas differs from those described above only in a) a slightly shorter pronotum and b) in coloration: the pale band on the face and prothorax is faint and restricted to the frons; antennae light brown, not purple-black; hind femora and tibia green-brown and green respectively, not black and purple. In the absence of a corresponding male it cannot be decided whether this specimen represents another species of the genus or a local colour variant. The latter is assumed here, but this individual is not included in the data of Table 1).



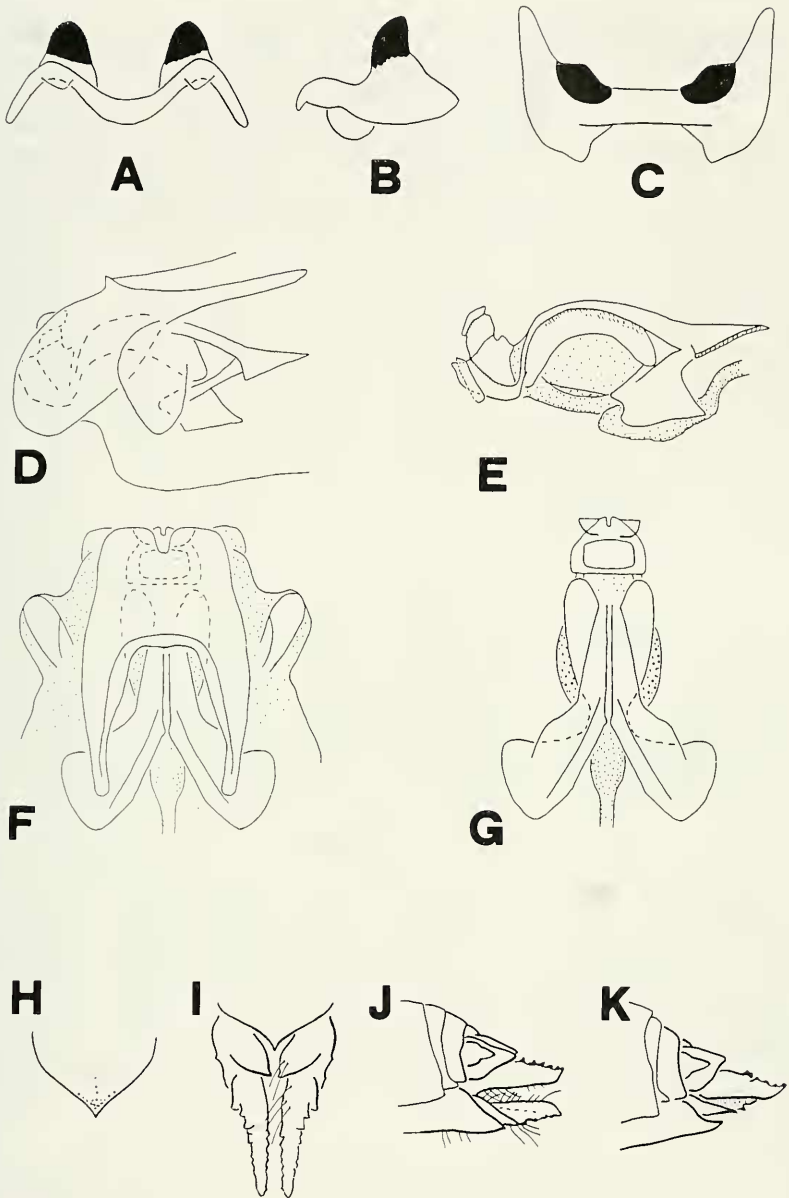


FIG. 3

*Exerythracris volcanica* n.sp. Figs. A-G, male. A-C, epiphallus: A, axial view. B, lateral view, C, dorsal view. D & F, endo- and ectophallus; D, lateral view, F, dorsal view. E & G, endophallus; E, lateral view, G, dorsal view. Figs H-K, female. H, posterior part of subgenital plate, ventral view. I, ovipositor valves, ventral view. J, tip of abdomen, lateral view, ovipositor valves open. K, as J, but valves shut.

Dimensions: See Table 1.

TABLE I  
*Exerythracris volcanica* n.sp.: dimensions.

	MEAN	S.D.	S.D./ MEAN	MAX	MIN	N
Males						
Dimensions (mm)						
Hind femur (F)	13.76	0.42	0.03	14.61	13.27	14
Rostrum-subgen. plate (L)	17.52	0.71	0.04	19.00	16.01	14
Pronotum (midline) (P)	3.20	0.10	0.03	3.39	3.02	14
Interocular space	0.37	0.03	0.08	0.41	0.32	14
Antennal pedicel (width)	0.53	0.02	0.04	0.57	0.48	14
Antennal flagellum (width)	0.30					1
Antenna (length)	12.94	1.18	0.09	15.25	11.40	7
Hind tarsus, 1st + 2nd segments	1.87	0.11	0.06	1.99	1.62	13
Hind tarsus, 3rd segment	2.80	0.12	0.04	3.00	2.66	12
Ratios						
F/P	4.31	0.11	0.03	4.50	4.15	14
L/P	5.48	0.22	0.04	5.83	5.09	14
Interoc./P	0.12	0.01	0.10	0.13	0.10	14
Interocular/pedicel	0.71	0.07	0.10	0.81	0.60	14
Tarsus 3/1+2	1.51	0.08	0.06	1.64	1.39	12
Tarsus 1+2+3/F	0.34	0.01	0.04	0.36	0.32	12
Tarsus 1+2+3/P	1.45	0.06	0.04	1.57	1.36	12
Antennal width/length as %	2.32%					1
Females						
Dimensions (mm)						
Hind femur (F)	15.21	0.61	0.04	15.95	14.65	4
Rostrum-ov. valves (L)	23.98	0.73	0.03	24.84	23.06	4
Pronotum (midline) (P)	3.87	0.23	0.06	4.16	3.66	4
Interocular space	0.55	0.04	0.07	0.58	0.51	4
Antennal pedicel (width)	0.60	0.04	0.07	0.65	0.56	4
Antenna (length)	12.03					1
Hind tarsus, 1st + 2nd segments	2.02	0.09	0.04	2.11	1.92	4
Hind tarsus, 3rd segment	2.86	0.29	0.10	3.12	2.45	4
Ratios						
F/P	3.93	0.07	0.02	4.00	3.83	4
L/P	6.21	0.45	0.07	6.66	5.80	4
Interoc./P	0.14	0.02	0.11	0.16	0.12	4
Interocular/pedicel	0.92	0.12	0.13	1.04	0.78	4
Tarsus 3/1+2	1.41	0.09	0.07	1.48	1.28	4
Tarsus 1+2+3/F	0.32	0.01	0.05	0.33	0.30	4
Tarsus 1+2+3/P	1.26	0.04	0.04	1.29	1.19	4

*Larvae.* The general coloration of the larvae is dull green and brown with reddish brown eyes and antennae. A number of larvae have been examined, but none reared throughout their development. Here I assume 5 larval instars:

I. Unknown.

II. Antennae with 8 flagellar segments, reddish brown. Eyes shining reddish brown. Legs and dorsal surfaces plain green, speckled reddish brown; ventral surface brown. Hind femora with 2 brown bands on inner and outer faces, knees brownish.

III. Antennae with 9 flagellar segments. Segments 2-6 bear an annulus, giving the impression of 14 segments in all. Eyes shining reddish brown. Well-marked medial dorsal carina on all thoracic and abdominal segments. Coloration as in instar II, except a) hind femoral bands fainter b) dark brown postocular stripe, more marked on head than on pronotum c) yellow flecks present on disc of pronotum.

IV. Antennae with 15 flagellar segments. Head bright green. Palps green. Dorsal surface of thorax and abdomen green flecked with brown. Yellow flecks on pronotum seen in III instar now enlarged to form a horizontal stripe below the postocular stripe, extending from pronotal lobes and around genae and frons (female only). Meso- and metathoracic epimera carmine red (male only). Underside black. Fore and mid legs black. Hind knees black, tibiae black.

V. Coloration as adult. 16 flagellar segments in antenna.

*Etymology:* "volcanica" of volcanoes, an allusion to both the distribution on the volcanoes of northern Costa Rica and the bright red colour.

*Distribution, natural history.* *E. volcanica* inhabits light gaps, path margins and woodland edges in wet montane forest between 1000 and 1200 m on the volcanic peaks of the Cordillera de Guanacaste and the Cordillera de Tilarán. Within the former it seems to have a disjunct distribution, being known from Volcán Tenorio (the Tierras Morenas site) in the South and from Volcán Cacao in the North, but not from the intervening peaks of Volcán Rincón de la Vieja or Volcán Miravalles. On Tenorio it is sympatric with *Hylopedetes surdus*, and in the Cordillera de Tilarán with both *H. surdus* and *H. gemmeus*, both of which belong to the same subfamily and have similar food preferences. Both *Exerythracris* and *Hylopedetes* are principally associated with and eat ferns, especially the secondary succession species *Hypolepis hostilis* (see also Rowell et al. 1983). A male *E. volcanica* has been seen attempting copulation with a female *H. surdus* and actively repelling males of the latter species while doing so.

### **Brakeracris** n. gen.

Type species: *Brakeracris varablancensis* n. sp.

*Male* (Fig. 4 & 5). Size small to medium. Integument polished except on head, the integument of which is matte. Dorsal surfaces of occiput, pro-, meso- and meta-nota and 1st abdominal tergum heavily pitted. Legs, frons and remaining abdominal segments smooth. Integument with numerous white hairs, especially on hind tibiae, genital area and distal underside of abdomen, but also sparsely on the dorsal surface.

Fastigium subhorizontal, triangular, truncate anteriorly, bearing a pair of prominent longitudinal ridges proximally, distally grooved, the groove reaching the anterior margin of fastigium (Fig. 4B, D, E). Frontal ridge narrower (0.8X) than interocular space, straight and almost parallel sided, slightly tapering ventrally, irregularly pitted in midline, ending above medial ocellus. Medial and ventral arms of subantennal suture short and deeply incised, dorsal arms thin and curved (Fig. 4E). Frons concave, upper part of frontal ridge forming a blunt rostrum (Fig. 4B), index 0.30. Preocular ridges well marked. Eyes globose. Interocular space narrower (0.7X) than maximum width of antennal pedicel. Antennae of medium length (3.57X length of pronotum), slightly flattened dorsoventrally and rather thick (width 0.032X their length), 17 segments in flagellum of adult.

Thorax (Fig. 4B, C). Medial carina present on pronotum anterior to 1st sulcus and posterior to 3rd sulcus, but absent between 1st - 2nd and 2nd - 3rd sulci. "Epaulettes" present between 2nd and 3rd sulci, but less well developed than in *Exerythracris* or *Talamancacris*. Posterior ventral angle of lateral lobe of pronotum rounded, posterior margin of pronotum slightly concave. Anterior ventral angle of lateral lobe with a small anteriorly directed projection (Fig. 4B). Posterior margins of pronotum slightly concave in midline, anterior margin straight or slightly notched. Prosternal process short, abruptly conical, vertical. Medial carina absent on meso- and metanotum. Apterous.

Hind femur relatively long, 4.1 - 4.2X as long as pronotum. Dorsal carina of femur minutely toothed proximally, smooth distally, ending in a spine which is shorter than lateral lobes of knee (Fig. 4G). Ventral carina smooth, lateral carinulae absent or very slight, outer face of hind femur rounded. Seven non-terminal spines on the dorsal external margin of hind tibia, 8 on the dorsal internal. Hind foot long, 0.34X as long as femur; 3rd tarsal segment relatively short, 1.26X as long as 1st and 2nd tarsal segments together.

Tympanum absent. Medial carina absent from 1st abdominal segment, present on 2-6th segments. Posterior margin of last abdominal tergite with a central notch and short lateral sclerotised teeth (Fig. 4F). Supraanal plate triangular, without sclerotised melanic markings, with a short longitudinal medial furrow at its base. Cerci short, conical, simple. Subgenital plate bluntly pointed in lateral view, terminating in a short medial furrow in dorsal view. Internal genitalia (Fig. 5) of the usual type for subfamily.

*Female.* The female is so far known only from several last instar larvae. Comparison of these with similarly aged larvae of other rhytidochrotine genera for which the female is known indicates that the adult female is likely to be of conventional form for the group, somewhat larger and more fusiform than the male, and with the characteristic ovipositor valves.

*Etymology:* Named for Dr. H.E. Braker, for her contribution to the discovery and original collection of all three new genera described in this paper.

*Diagnosis.* *Brakeracris* seems to be related to the Costa Rican *Scirtopaon* (Fig. 9). It shares with this genus the presence of a weak medial carina on the anterior and

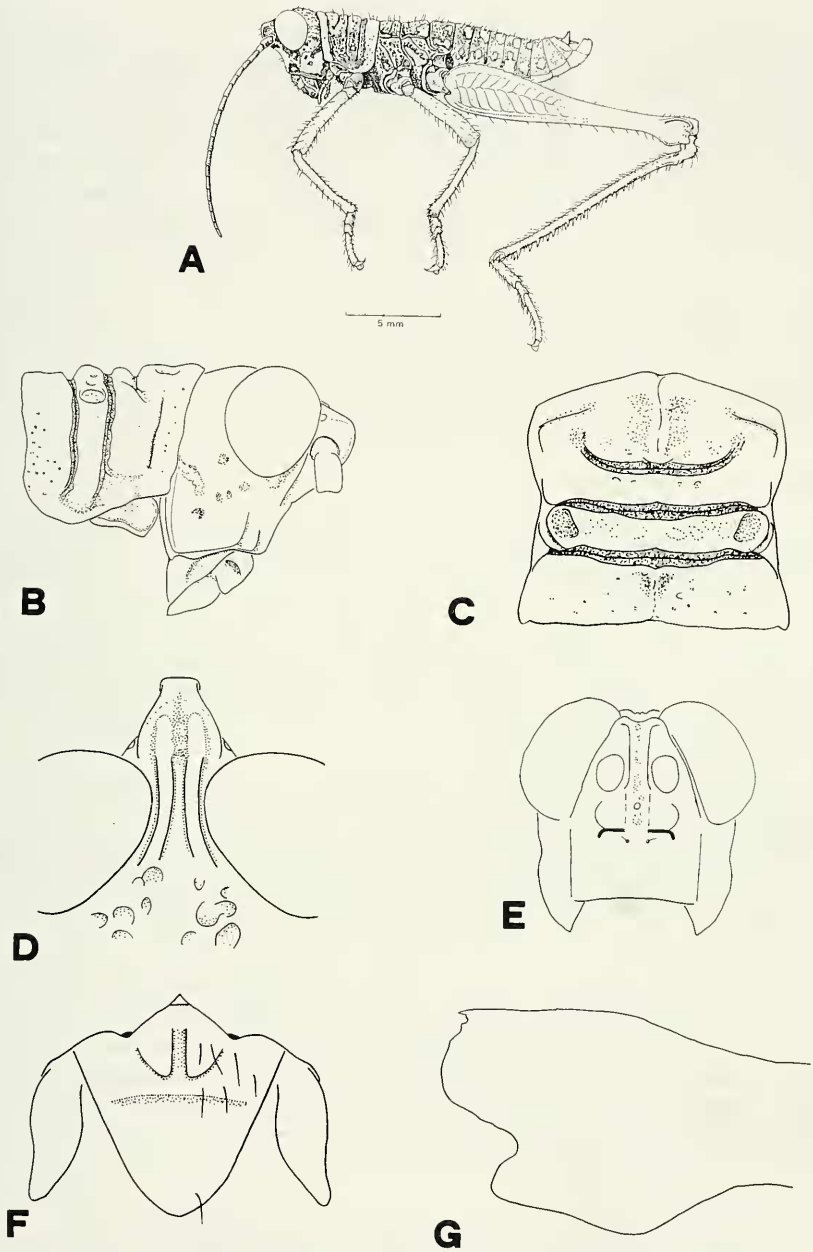


FIG. 4

*Brakeracris varablancensis* n.sp. Male. A, lateral view of entire insect. B, lateral view of head and pronotum. C, dorsal view of pronotum. D, dorsal view of head. E, frontal view of face. F, dorsal view of furcula, supraanal plate and cerci. G, lateral view of hind knee.

posterior sections of the pronotum (Fig. 9B) and on the posterior abdominal segments; the slight anterior projection of the anterior ventral angle of the pronotum (Fig. 9A); the size and shape of the terminal spine of the hind knee (Fig. 9H). It differs from *Scirtopaon* as follows: frontal ridge with subparallel margins, and not with a double constriction as in *Scirtopaon* (Fig. 9D); medial and ventral antennal sutures strongly excavated (medial and dorsal in *Scirtopaon* (Fig. 9D)); shorter and thicker antennae; more prominent rostrum (index 0.30, compared with 0.26 in *Scirtopaon*); in the detail of the rugosities of the pronotum (Fig. 9A, B); in the less well developed teeth of the furcula; in the shape of the lophi - in *Scirtopaon* (Fig. 9F, G) these have a prominent lateral ridge which is absent in *Brakeracris*, and are not tilted caudally as in *Brakeracris*. *B. varablancensis* shows none of the extreme values in the morphometric ratios (Table. 4), but has a rather larger rostrum than most other taxa and the relatively thickest antennae of all but *Talamancaacris*.

### ***Brakeracris varablancensis* n. sp.**

Holotype ♂ (specimen no. RC 86495a) COSTA RICA: Prov. Heredia, 3 km. E. of S. Rafael de Vara Blanca, 1800-2100 m., map ref. N239800, E524200, 13 April 1986, (C.H.F. Rowell & H.E. Braker), ANSP. Paratype: 1 ♂, same data as holotype (RC). Last instar larvae: 6 ♀♀, same data as holotype (2 in ANSP, otherwise RC).

*Male*. Alive a predominantly greenish-black insect with bright yellow markings and green legs. Antennae black; eyes, black; palps, green; suborbital band on frons and genae, yellow; remainder of head, black. Pronotum black with yellow border; thoracic and abdominal tergites olive green with yellow markings. Coloration otherwise as for pinned specimen.

Description of pinned specimens. Basal segments of antenna green, distal segments dark brown. Eyes reddish brown. Ventral half of frons and genae cream. Remainder of head blackish green. Thorax and abdomen olive green, underside olive brown. Entire margin of pronotum bordered in deep yellow apart from a short stretch dorsal to prothoracic coxal insertion. Metathoracic episternum yellow. Posterior margin of metanotum with 2 yellow marks. Terga of abdominal segments 1-8 each bear a pair of yellow chevrons in the midline and paired yellow spots laterally. Legs dark green, lunules of hind knee reddish, 3rd tarsal segments black.

Internal genitalia: lophi of epiphallus conical, sclerotised, minutely denticled, widely separated and with inner faces parallel or only slightly divergent in axial view (Fig. 5A), tilted slightly caudally in lateral view (Fig. 5B). Remainder of genitalia without particular distinguishing features.

Larval coloration (male):

I instar: unknown.

II instar: uniform dull reddish brown. Antennae slightly clubbed, pink at tip. Inner surface of hind femur with 3 weakly marked darker bands.

III. instar: Thoracic tegument more rugose than in II. Fore and mid legs green. Hind leg brown, femur with 3 dark bands.

IV. instar. Pattern similar to that of the adult, but expressed in pink on reddish brown instead of yellow on greenish black. Legs tinged green.

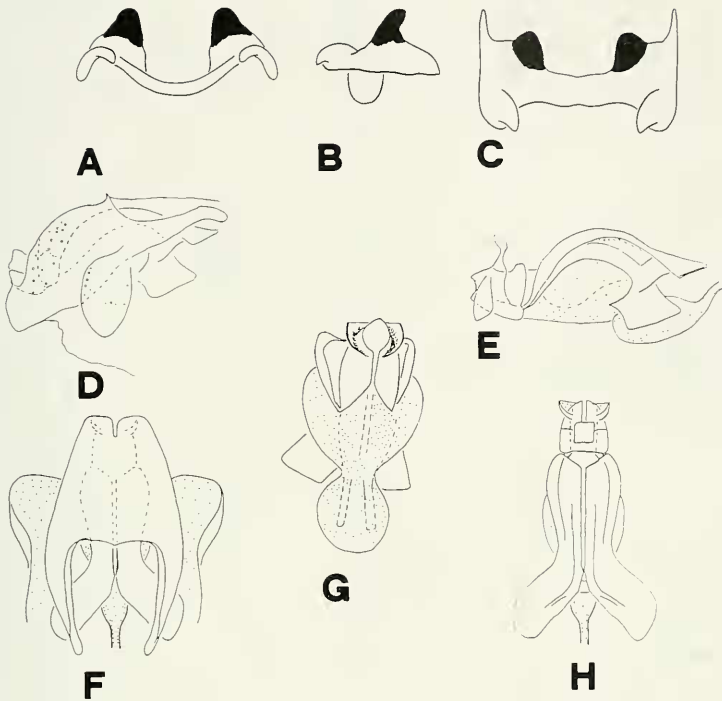


FIG. 5

*Brakeracris varablancensis* n.sp. Male. A-C, epiphallus: A, axial view, B, lateral view, C, dorsal view. D, F, endo- and ectophallus: D, lateral view, F, dorsal view. E, G & H, endophallus: E, lateral view, G, perspective view from below and to one side, H, dorsal view.

V instar: as adult.

Larval coloration (female):

The early instar female larvae do not differ from the males, the last instar larva differs from the adult and last instar male as follows: coloration duller, less contrasty. Lower half of pronotal lateral lobe yellow. Pronotum without the clear yellow border of the male. Abdominal terga with a single triangular yellowish patch, not with paired chevrons and spots as in the male.

*Dimensions*: See Table 2.

*Etymology*: varablancensis, of Vara Blanca, the type locality.

*Distribution, natural history*. *B. varablancensis* is known to date only from around S. Rafael de Vara Blanca, on the northern scarp of the Cordillera Central, in the headwaters of the Río Sarapiquí, altitude 1900 to 2200 m. In March 1986 it was found in regenerating scrub at the forest edge above the farmhouse (now situated in the Parque Nacional Braulio-Carrillo) and also on landslip areas bordering two stream

TABLE 2

*Brakeracris varablancensis* n.sp.: dimensions.

	MEAN	MAX	MIN	N
Males				
Dimensions (mm)				
Hind femur (F)	12.92	13.11	12.73	2
Rostrum-subgen. plate (L)	15.99	16.61	15.36	2
Pronotum (midline) (P)	3.09	3.09	3.08	2
Interocular space	0.40	0.40	0.40	2
Antennal pedicel (width)	0.57	0.59	0.54	2
Antennal flagellum (width)	0.35			1
Antenna (length)	11.00			1
Hind tarsus, 1st + 2nd segments	1.95			1
Hind tarsus, 3rd segment	2.45			1
Ratios				
F/P	4.19	4.26	4.12	2
L/P	5.18	5.38	4.99	2
Interoc./P	0.13	0.13	0.13	2
Interocular/pedicel	0.71	0.74	0.68	2
Tarsus 3/ 1+2	1.26			1
Tarsus 1+2+3/F	0.34			1
Tarsus 1+2+3/P	1.43			1
Antennal width/length as %	3.18%			1

beds traversing dense montane wet forest 1-2 km north of the farmhouse. Most individuals seen were mid or late larval instars; only two adult males were found, and no adult females, despite intensive search. There was no obvious association between *B. varablancensis* and any particular plant species. In captivity it nibbled at a variety of plants from the habitat, but ate well from none of those tested, which included several species of ferns. In the same localities were found the acridids *Drymacris nebulicola* (Proctolabinae) on Solanaceous plants and *Silvitettix communis* (Gomphocerinae) on grasses.

Intensive search of the same areas under fine weather conditions in July 1991 produced only a single 3rd instar larva and no adults. This may indicate marked seasonality, or might be due to the extensive vegetational change seen, corresponding to 5 years of secondary succession. This larva ate various *Senecio* spp. from other parts of Costa Rica in the following days, suggesting that *B. varablancensis*, like *T. palustris* (below), may prefer Asteraceae.

### Talamancacris n. gen.

Type species: *Talamancacris palustris* n. sp.

*Male*. (Figs. 6 & 7). Size small-medium. Integument highly polished except on head, which is matte. Frons, genae, dorsal surfaces of occiput, and of pronotum



posterior to the last transverse sulcus, lightly pitted; remaining areas smooth and glossy, as though clear varnished. Integument with numerous white hairs, especially on the tibiae, proximal hind femora, genital area and meso- and metathoracic sterna, and also bilateral tufts dorsolaterally near anterior margin of each abdominal segment.

Fastigium inclined, triangular, truncate anteriorly, with two low longitudinal ridges proximally, shallowly grooved distally, lateral margins straight or slightly concave (Fig. 6B, D). Frontal ridge at its widest point narrower (0.6X) than interocular space, subparallel sided, somewhat narrower at dorsal and ventral extremities, extending to lower rim of antennal foramen, slightly divergent above medial ocellus; shallowly grooved medially for a short distance dorsal to medial ocellus, lightly pitted between this point and fastigium (Fig. 6E). Medial ocellus barely visible. Medial and ventral arms of subantennal suture short and rather deeply incised, dorsal arms thin and indistinct (Fig. 6E). Profile of frons concave, upper part of frontal ridge forming a short (index 0.30), vertically ended rostrum (Fig. 6B). Preocular ridges present. Eyes globose. Interocular space slightly wider (1.1X) than width of antennal pedicel. Antennae filiform, somewhat dorsoventrally flattened, short (2.8X as long as pronotum) and thick (0.042X their length), 17 segments in flagellum of adult.

Pronotum (Fig. 6B, C) slightly inflated in midline anterior to 1st sulcus, but no medial carina present. Sulci deep; well developed "epaulettes" present between the 2nd and 3rd sulci. Posterior ventral angle of lateral lobe of pronotum rounded, somewhat lobate, projecting ventrally and posteriorly (Fig. 6B). Anterior ventral angle rounded. Posterior margins of pronotum slightly concave in midline, anterior margin convex and minutely notched (Fig. 6C). Prosternal process short, abruptly conical, vertical. Medial carina absent from meso- and metanotum. Apterous.

Hind femur relatively short, 3.57X as long as pronotum. Dorsal carinae of femur well marked over most of its length, slightly toothed, obsolete immediately before the knee, terminating in a sharp spine which exceeds in length the outer lateral lobes of the knee (Fig. 6G). Ventral carina strongly developed, smooth, lateral carinulae absent or very slight, outer face of hind femur rounded in cross section. Seven non-terminal spines on external dorsal margin of hind tibia, 8 on internal dorsal margin. Hind tarsus long in relation to femur (0.32X), but smaller than in the other Costa Rican genera in relation to the pronotum (1.13X); 3rd tarsal segment of hind leg slightly (1.28 X) longer than 1st and 2nd tarsal segments together.

Tympanum absent. Medial carina absent from 1st but present on 2-6th abdominal segments. Posterior margin of last abdominal tergite with a central notch and short lateral sclerotised teeth (Fig. 6F). Supraanal plate triangular, without sclerotised melanic markings, with a short longitudinal medial furrow at its base (Fig. 6F). Cerci short, conical, simple. Subgenital plate bluntly pointed in lateral view, terminating in a short medial furrow behind the tip of the supraanal plate, glabrous in ventral and apical midline, pilose laterally. Internal genitalia (Fig. 7A-G) of the usual type for the subfamily. Epiphallus distinctive (Fig. 7A-C).

*Female*. Size, small to medium. Differs from male in following morphological characters: larger (1.38x in overall length) and more fusiform, wider in posterior thorax and anterior abdominal segments (Fig. 7K). Ovipositor valves (Fig. 7H-J) long,

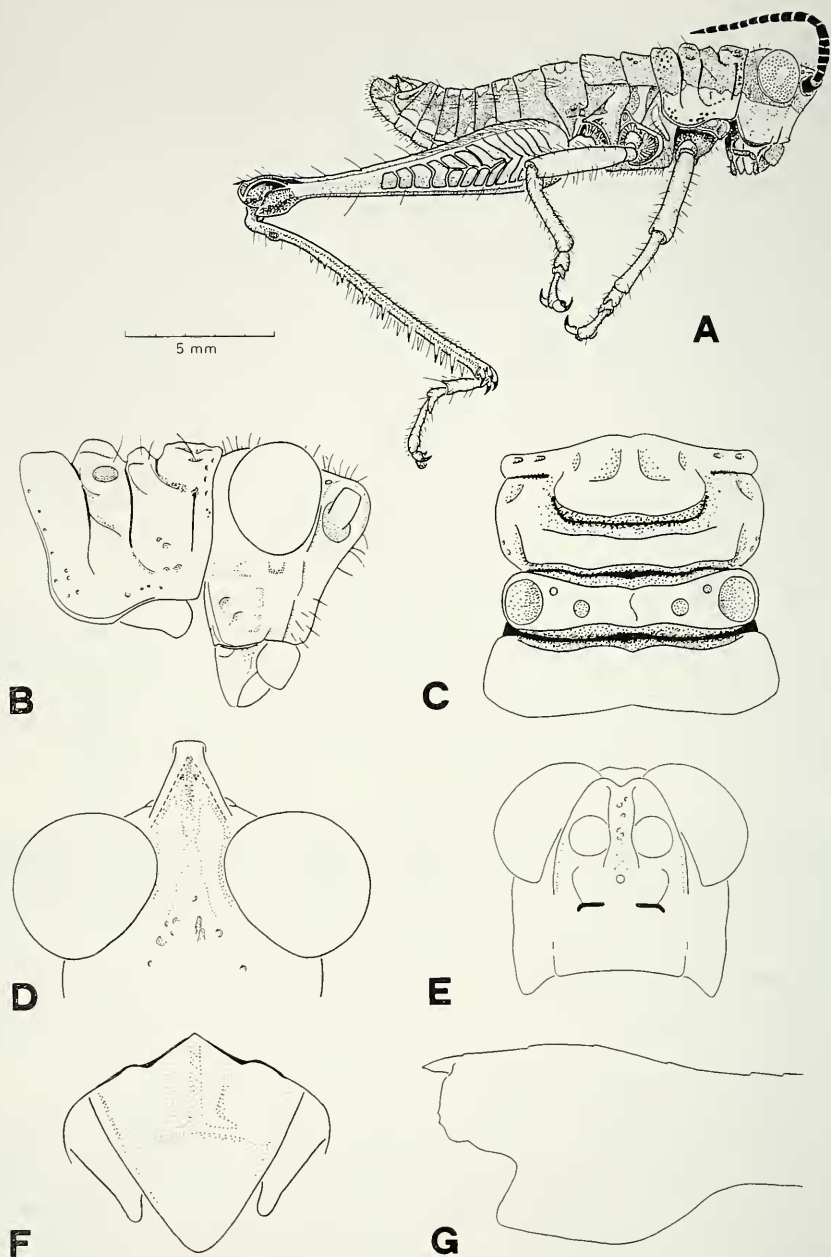


FIG. 6

*Talamancacris palustris* n.sp. Male. A, lateral view of entire insect. B, lateral view of head and pronotum. C, dorsal view of pronotum. D, dorsal view of head. E, frontal view of face. F, dorsal view of furcula, supraanal plate and cerci. G, lateral view of hind knee.

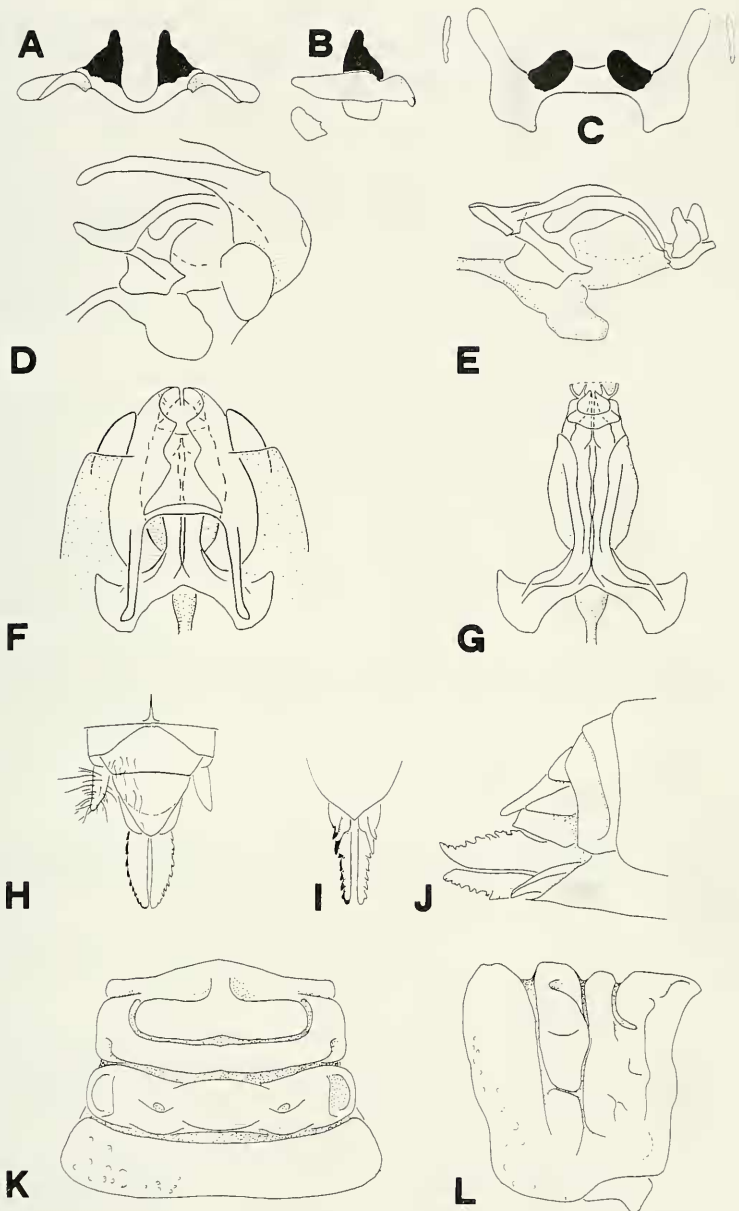


FIG. 7

*Talamancacris palustris* n.sp. Figs. A-G, male. A-C, epiphallus; A, axial view, B, lateral view, C, dorsal view. D & F, endo- and ectophallus, D, lateral view, F, dorsal view. E & G, endophallus; E, lateral view, G, dorsal view. Figs H-L, female. H, tip of abdomen, dorsal view. I, ovipositor valves and posterior end of subgenital plate, ventral view. J, tip of abdomen, lateral view, ovipositor valves open. K, pronotum, dorsal view. L, pronotum, lateral view.

projecting 1.12 mm beyond end of the subgenital plate. Both upper and lower ovipositor valves heavily toothed on exterior outer margins, smooth on inner margins. Lower valves narrow, normally held between upper valves, with a shoulder proximally on lateral ventral edge. Subgenital plate (Fig. 7I) with concave posterior edges, forming a medial point. Spermatheca not examined.

*Diagnosis.* *Talamancacris* differs from all other Costa Rican rhytidochrotines in that a) the terminal spine of the hind knee projects well beyond the lateral lobes b) the interocular space exceeds the maximum width of the first antennal segment and c) in the shape of the male epiphallus. It is also much more hirsute than the other genera. The dimensional comparison with other genera is shown in Table 4. *Talamancacris* has the highest number of extreme morphometric ratios of any of the taxa studied: the shortest overall length relative to the pronotum, the widest interocular space, the shortest hind tarsus relative to the pronotum, and the relatively shortest and thickest antennae. *Talamancacris* gives a first impression of a small, short legged version of *Brakeracris*; especially the profile of the head and the form of the frontal ridge and the antennal sutures are very alike in the two genera. The abdomen, legs and antennae are however relatively much shorter (relative to pronotum), the antennae are relatively thicker (0.042x their length, 0.032 in *Brakeracris*), the pronotum has no medial carina, its anterior ventral angle lacks projections, and the integument is glossy and smooth.

*Etymology:* Talamanca, the range of mountains in central Costa Rica where all known localities of the genus are located; acris, conventionally used for grasshopper.

### ***Talamancacris palustris* n. sp.**

Holotype ♂ (specimen no. RC 93371): COSTA RICA, Prov. Cartago, Turbera "La Chonta", 2.7km SSE of El Empalme, 2'380 m, map ref. N188200, E542300, 20 Sep 1993, (C.H.F. Rowell & G. Vargas). Allotype ♀ (specimen no. RC 93372), same data. Both in ANSP. Paratype: 1 ♀ (specimen no. RC 79228): COSTA RICA, Prov. S. José, Puya bog, Km 67.5, Rta 2, nr. Salsipuedes, 2550 m, 25 August 1979 (H.E. Braker) (MNHNP). Last instar larvae: 2 ♂♂, 1 ♀, same data, but 16 July 1980 (C.H.F. Rowell & M. Rowell-Rahier); 2 ♂♂, same locality as holotype, but 25 January 1991 (G. Vargas & H.E. Braker); all RC.

Both sexes alive are dark metallic bluish green, with black antennae and eyes, a shining white facial and pronotal stripe, paired lighter green chevrons on each abdominal tergum, and reddish hind knees. The striking blue-green colour fades to brown an hour or two after death and is probably structural in origin.

Description of pinned specimens: Male. Antennae black, brown at tips. Eyes dark brown. Lower frons and genae yellow. Head otherwise dark blue green with yellow V-shaped marking on occiput and fastigium. Thorax and abdomen blackish brown shading to green at anterior and posterior margins of pronotum and around bases of anterior legs. Ventral half of lateral lobe of prothorax yellow. Pro- and mesothoracic epimera yellow. Legs dark olive brown. Tibial spines olive green tipped with brown. Hind knees blackish green. Abdominal segments 2-6 with a pair of yellow triangular marks tending to fuse in midline. Cerci brown.

Internal genitalia (Fig. 7A-G) of usual type for the group. Epiphallus distinctive: lophi (Fig. 7A-C) vertical in axial view, very slender at their tips, with a sloping lateral ridge, posterior margin of lateral processes slightly incised at the base of the lophi. Lateral sclerites present.

Female. Antennal basal segments green, distal segments dark brown. Eyes reddish brown. Ventral half of frons and genae cream. Remainder of head olive brown with a lighter V-shaped marking on the occiput. Thorax, abdomen and legs olive green with reddish brown mottle. Underside olive brown. Lower half of prothoracic lateral lobes pale yellow brown.

*Dimensions*: see Table 3.

TABLE 3  
*Talamancacris palustris* n.sp.: dimensions.

	MEAN	MAX	MIN	N
Males				
Dimensions (mm)				
Hind femur (F)	11.46			1
Rostrum-subgen. plate (L)	14.47			1
Pronotum (midline) (P)	3.21			1
Interocular space	0.60			1
Antennal pedicel (width)	0.54			1
Antennal flagellum (width)	0.38			1
Antenna (length)	9.00			1
Hind tarsus, 1st + 2nd segments	1.60			1
Hind tarsus, 3rd segment	2.04			1
Ratios				
F/P	3.57			1
L/P	4.51			1
Interoc./P	0.19			1
Interoc./pedicel	1.11			1
Tarsus 3/ 1+2	1.28			1
Tarsus 1+2+3/F	0.32			1
Tarsus 1+2+3/P	1.13			1
Antennal width/length as %	4.22%			1
Females				
Dimensions (mm)				
Hind femur (F)	13.12	13.21	13.02	2
Rostrum-ov. valves (L)	19.97	21.53	18.41	2
Pronotum (midline) (P)	3.90	3.93	3.87	2
Interocular space	0.72	0.74	0.70	2
Antennal pedicel (width)	0.61	0.62	0.60	2
Antenna (length)	9.80	10.39	9.20	2
Hind tarsus, 1st + 2nd segments	2.00	2.03	1.97	2
Hind tarsus, 3rd segment	2.19	2.29	2.09	2
Ratios				
F/P	3.36	3.41	3.31	2
L/P	5.12	5.48	4.76	2
Interoc./P	0.18	0.19	0.18	2
Interoc./pedicel	1.18	1.23	1.13	2
Tarsus 3/ 1+2	1.10	1.16	1.03	2
Tarsus 1+2+3/F	0.32	0.33	0.31	2
Tarsus 1+2+3/P	1.07	1.08	1.06	2

Larvae:

I instar: unknown.

II instar: uniform dull reddish brown.

III - V instars: coloration similar to that of adults, but less contrasty. Some female larvae have 2 pale blotches on the dorsal edge of the hind femur.

*Etymology*: "palustris", of swamps, after the habitat of the species.

*Distribution, natural history*. *T. palustris* is known only from a few bogs lying between 2300 and 2600 m altitude on the Atlantic side of the north slope of the Talamanca range. All localities have a similar and very characteristic vegetation dominated at ground layer by *Sphagnum* moss and the rush-like *Xyris* (Xyriaceae); the main emergents are the large fern *Blechnum* and the terrestrial Bromeliad *Puya*. This characteristic plant assemblage, otherwise known only from the Andes, is confined to certain areas of restricted drainage which appear to date from after the end of the last glaciation (G. Vargas, pers. comm.). The only other acridoid found in or near these bogs is the Oedipodine *Chortophaga viridifasciata* (De Geer, 1773).

*Phenology*. Larvae have been found in January, July, August and September, but not in April; adults have been found in August and September. A third instar female larva captured 20th September and maintained in captivity became adult on 5th November. These data are compatible with the hypothesis that there is one generation per year and that eggs are laid in the first half of the year, as is common among Costa Rican acridids, but do not exclude the possibility that breeding takes place year round.

*Foodplants*. *T. palustris* is not obviously associated with any particular plant species in its habitat. It is found on the vegetation covering the bog surface, and not in the emergent shrubs, bromeliads or ferns. Consistent with this observation it refuses in captivity *Puya*, *Blechnum* and the Ericaceous shrub *Pernettya*. It also refuses *Sphagnum* and *Xyris* and a variety of other plants growing with them. The only plant from the native habitat which *Talamancacris* has accepted in captivity is *Hieracium stanleyi* (Asteraceae). In captivity it refuses all monocots and most exotic dicots, but accepts a variety of cultivated Asteraceae, including *Doronicum* and *Dahlia*, especially the latter. (*Dahlia imperialis* is indigenous to Costa Rica and grows within some kilometres of the bogs inhabited by *T. palustris*, but is not present within them). Some but not all individuals accept in captivity the fern *Hypolepis hostilis* (the commonest food of two other Costa Rican rhytidochrotine genera, *Hylopedetes* and *Exerythracris* (ROWELL *et al.* 1983; this paper)) or *Rubus* nr. *glaucus* (eaten in the wild by the Costa Rican rhytidochrotine *Scirtopaon dorsatus* (pers. obs.)), but do not eat either of them in quantity. Neither plant is present in the natural habitat. These observations suggest a specialisation of *Talamancacris* on Asteraceae, perhaps normally *H. stanleyi*.

#### PREVIOUSLY DESCRIBED TAXA

The original descriptions of the remaining three Costa Rican genera (*Hylopedetes*, *Scirtopaon* and *Micropaon*) were not well provided with measurements or

anatomical drawings. The following section is intended primarily to allow comparison of the newly described genera with those previously described.

Table 4 compare the dimensions of the known atympanate genera. The data for some are incomplete; in several cases only one of the two sexes is known.

### **Hylopedetes** Rehn, 1929

(Fig. 8)

The genus is well differentiated from the remaining Costa Rican genera by the weak first pronotal sulcus, the ventrally directed process at the anterior angle of the pronotum (Fig. 8A), and the distinctive convergent lophi of the epiphallus (Fig. 8G). *Hylopedetes* has the smallest relative interocular distance of any of the genera examined, and (together with *Talamancacris*) the relatively shortest antennae. The pattern of the antennal sutures is similar to that of *Exerythracris*, with which it also shares a proportionately very long last segment of the hind tarsus. The male and female genitalia of *H. mirandus* were figured by DESCAMPS & AMÉDÉGNATO (1972b: Figs 2-8); Table 4 presents its dimensions. The 5 species of the genus are similar morphologically, the most different being *H. nigrithorax*. A key to the species was given by DESCAMPS & ROWELL (1978).

*H. mirandus* Rehn, 1929 (the type species) has previously been reported only from the type locality, La Emilia, Guápiles, which is now completely deforested and suburban. Four new localities are now known. Three lie in the valley of the Río Toro Amarillo, 15 and 10 km S. and 7 km W. of Guápiles, at 800, 540 and 305 m respectively, a fourth 8km SW of Guápiles in the valley of the Río Sucio at 550 m. It is probable that the species occurs in suitable places (at forest edges and in light gaps on ferns, especially on *Hypolepis hostilis*) at least throughout the intervening area, and perhaps further up the scarp beyond. Guápiles itself lies at 260 m. on the edge of the Caribbean plain at the foot of the scarp of the Cordillera Central, and the nature of the original forest vegetation changed sharply north of and below this point. The type locality probably represented the lower altitudinal limit of the species, the genus and (at least in Central America) of the subfamily.

*H. nigrithorax* Descamps & Rowell, 1978. This is to date the only rhytidochrotine known from the southwest of Costa Rica (contrary to the statement by DESCAMPS & AMÉDÉGNATO (1972b: 1058), the species of *Hylopedetes* described by Rehn are from the Atlantic and not the Pacific slope of the country). Originally described from a single locality on the Fila Cruces near the town of S. Vito de Coto Brus, *H. nigrithorax* is now known from several other nearby localities lying to the north and south along this same ridge, at altitudes between 1100 and 1700 m. The Fila Cruces forms the most southwesterly ridge of high ground before the Pacific plain of SW Costa Rica. It is not known whether the species extends south into Panama; it was not collected in the '30s by D.W. Bishop from El Volcán in Chiriquí, where he found several other species that in Costa Rica are sympatric with *H. nigrithorax*. The preference of *H. nigrithorax* at the type locality for certain species of ferns (including again *Hypolepis hostilis*) was documented previously (ROWELL *et al.* 1984); however, it can sometimes be found on Asteraceae.

TABLE 4A

Comparison of the mean dimensions of the type species of non-tympanate rhytidochrotrine genera. Males.

	<i>Everythra- acris volcanica</i>	<i>Hypopedetes mirandus</i>	<i>Micropaon lucens</i>	<i>Scirtopaon dorsatus</i>	<i>Brocker- acris varablan censis</i>	<i>Talamanc- acris pallastris</i>	<i>Paropaon laevifrons</i>	<i>Lathacris rubiven- tris</i>	<i>Maysc- acris panchlonga</i>	<i>Loepacris obscuripes</i>
N:	14	6	1-2	1	2	1	2	1*	2	1*
Mean dimensions in mm:										
Hind femur (F)	13.76	10.78	11.12	13.69	12.92	11.46	9.74	6.10	9.74	unknown
Rostrum-subgen. plate (L)	17.52	13.91	15.01	17.48	15.99	14.47	14.31		14.31	
Pronotum (midline) (P)	3.20	2.64	2.57	3.16	3.09	3.21	2.46		2.46	2.10
Interocular space	0.37	0.26	0.32	0.45	0.40	0.60	0.41		0.41	
Antennal pedicel (width)	0.53	0.41	0.42	0.47	0.57	0.54	0.41		0.41	
Width of antennal flagellum	0.30	0.21	0.22	0.29	0.35	0.38				
Antenna (length) (A)	12.94	8.52	9.60	13.30	11.00	9.00	9.90		9.90	
Hind tarsus 1st & 2nd segments	1.87	1.33	1.69	2.15	1.95	1.60	1.57		1.57	
Hind tarsus 3rd segment	2.80	1.95	2.11	2.74	2.45	2.04	1.94		1.94	
Ratios										
F/P	4.31	4.09	4.32	4.33	4.19	3.57	3.96		3.96	2.90
L/P	5.48	5.28	5.91	5.53	5.18	4.51	5.82		5.82	
Interoc./P	0.12	0.10	0.13	0.14	0.13	0.19	0.16		0.16	
Interoc./pedicel	0.71	0.65	0.76	0.96	0.71	1.11	1.00		1.00	
Tarsus 3/1+2	1.51	1.47	1.25	1.27	1.26	1.28	1.24		1.24	
Tarsus 1+2+3/F	0.34	0.30	0.35	0.36	0.34	0.32	0.36		0.36	
Tarsus 1+2+3/P	1.45	1.24	1.50	1.55	1.43	1.13	1.42		1.42	
A/P	4.05	3.23	3.78	4.21	3.57	2.80	4.03		4.03	
A/F	0.94	0.79	0.86	0.97	0.85	0.79	1.02		1.02	
Ant width/length as %	2.32	2.47	2.29	2.18	3.18	4.22	2.02		2.02	
Rostrum index (see Fig. 1)	0.33	0.28	0.23	0.26	0.30	0.30	0.29		0.29	0.23

\* data from original description.



TABLE 4B  
Comparison of the mean dimensions of the type species of non-tympanate rhytidochrotine genera. Females.

	<i>Everyth- acris</i>	<i>Hypopedetes mirandus</i>	<i>Micropaon lucens</i>	<i>Scirtopaon dorsatus</i>	<i>Braker- acris</i>	<i>Talamanc- acris</i>	<i>Paropaon laevifrons</i>	<i>Lathacris rubiven- tris</i>	<i>Muysc- acris</i>	<i>Loepacris obscuripes</i>
Females:	4	6	1*	1*	2	2	2	1*	1*	1*
N:										
Mean dimensions in mm:										
Hind femur	15.21	12.72	13.00	13.50	female	13.12	10.87	female	17.00	15.10
Rostrum-subgen. plate	23.98	18.20		not	not	19.97	17.99	not	28.30	
Pronotum (midline) (P)	3.87	3.31	3.00	3.60	known	3.90	2.97	known	4.70	3.70
Interocular space	0.55	0.34				0.72	0.57			
Antennal pedicel (width)	0.60	0.43				0.61	0.43			
Antenna (length) (A)	12.03	7.55				9.80	9.13			
Hind tarsus 1st & 2nd segments	2.02	1.55				2.00	1.57			
Hind tarsus 3rd segment	2.86	2.17				2.19	2.05			
Ratios										
Femur/Pronotum	3.93	3.85	4.33	3.75		3.36	3.66		3.62	4.08
Length/Pronotum	6.21	5.51				5.12	6.06		6.02	
Interoc./Pronotum	0.14	0.10				0.18	0.19			
Interocular/pedicel	0.92	0.81				1.18	1.33			
Tarsus 3/1+2	1.41	1.40				1.10	1.30			
Tarsus 1+2+3/F	0.32	0.29				0.32	0.33			
Tarsus 1+2+3/P	1.26	1.13				1.07	1.22			
A/P	3.11	2.28				2.51	3.08			
A/F	0.79	0.59				0.75	0.84			

\* data from original description.

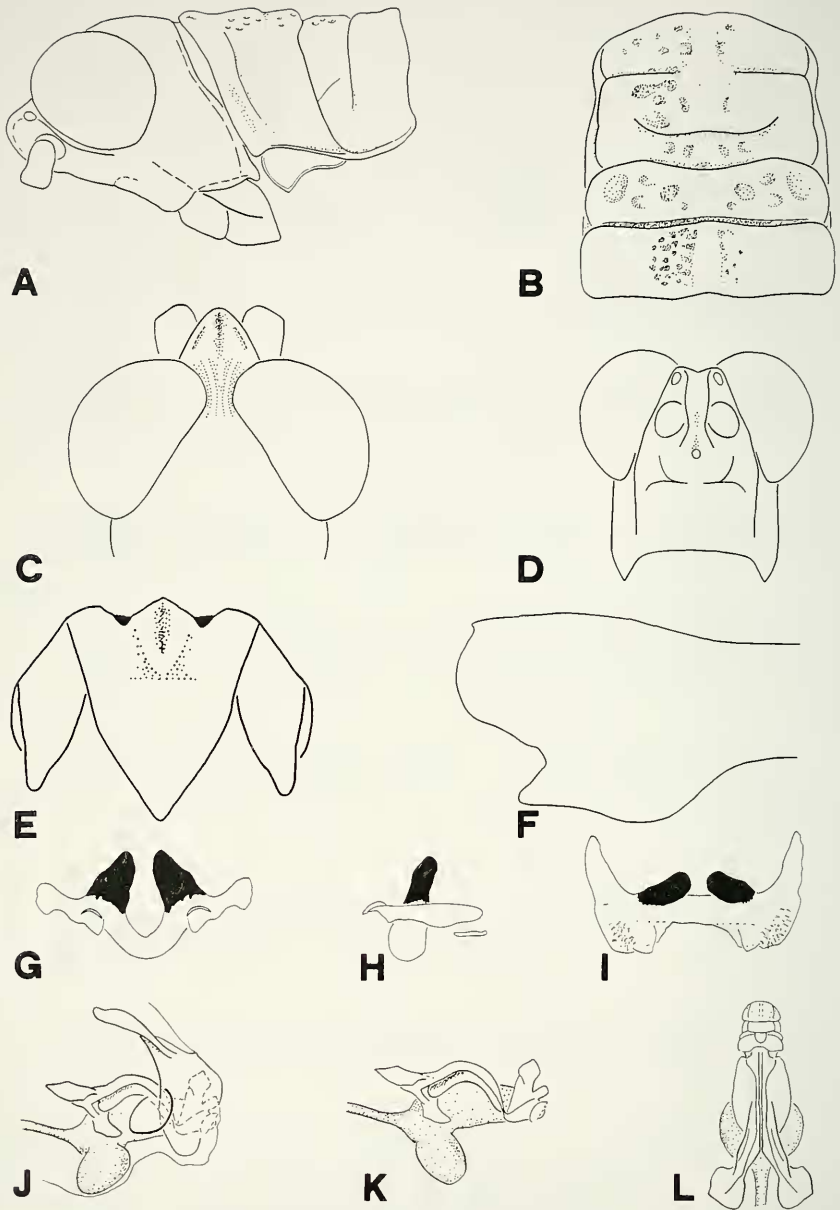


FIG. 8

*Hylopedetes mirandus* Rehn, 1929. Male. A, lateral view of head and pronotum. B, dorsal view of pronotum. C, dorsal view of head. D, frontal view of face. E, dorsal view of furcula, supraanal plate and cerci. F, lateral view of hind knee. G-I, epiphallus; G, axial view, H, lateral view, I, dorsal view. J, Endo- and ectophallus, lateral view. K & L, endophallus; K, lateral view, L, dorsal view. (The whole animal (both male and female) is figured in the original description. DESCAMPS & AMÉDÉGNATO (1972b, Figs. 2-8) give other drawings, including additionally the female genitalia).

The remaining three species of the genus are characteristic of the northern and central mountains of Costa Rica, and have rather wider distributions than *nigrithorax* and *mirandus*.

*H. surdus* Descamps & Rowell, 1978 has the largest range of any *Hylopedetes* sp. and is also the commonest. It is sympatric with *H. gemmeus* over almost the entire range of the latter and extends further north, at least as far as Volcán Tenorio, where it is sympatric with *E. volcanica*. It appears to be less shade tolerant than *gemmeus*, but like it is found on a variety of ferns, including *Hypolepis*. In the North and West of its range *H. surdus* has orange hind knees, whereas to the South and East the hind leg is entirely green. No other morphological difference can be discerned between these colour forms. Museum specimens of the northern form of *H. surdus* can at first be confused with *H. mirandus*, which also has pale knees. In life the true colours are distinctive and the two species cannot be confused.

*H. cruentus* Rehn, 1929 occurs principally in an arc open to the NE around the headwaters of the Rio Reventazón, between 1100 and 1700 m. The type locality (near Navarro) lies on the southern arm of this arc, and it is also found at other localities in the area between Cartago and Tapantí. Not apparently present on the Cerro de Carpintera on the Continental Divide between Cartago and San José, it occurs again on the southern slopes of Volcán Turrialba and is present on the north facing slope of Cerro Zurquí. *H. cruentus* will eat the usual ferns in captivity, but in nature shows no strong association with them. It is usually found in mixed vegetation at woodland edges, often basking on leaves of *Piper* spp.

*H. gemmeus* Rehn, 1929 is the species most likely to be found in thick forest at low light intensities. It too is usually found on ferns, especially members of the genera *Dryopteris* and *Pteris*. It is now known from the Cordillera de Tilarán in the north and from there south and east along the north slope of the Cordillera Central at least as far as the Río Frío. The type locality (the same as that of *H. cruentus*), however, lies well to the south of this, in the Talamanca foothills at Navarro, but the species has not been seen there since the original collection. This may be a consequence of the general forest degradation in that area.

***Scirtopaon dorsatus* Descamps & Rowell, 1984**

(Fig. 9)

Readily distinguished by the combination of blunt rostrum, incomplete pronotal medial carina, and long, thin, filiform antennae, and by the pattern of the antennal sutures. Originally described from Monteverde, in the Cordillera de Tilarán, *S. dorsatus* is now additionally known from the head waters of the Río Sarapiquí, near Cinchona in the Cordillera Central. Patchy, never common, and rather cryptic, the species is easy to overlook, and probably will ultimately prove to have a range similar to that of *H. gemmeus*. It is not a fern or grass eater, but is associated with a variety of montane dicots.

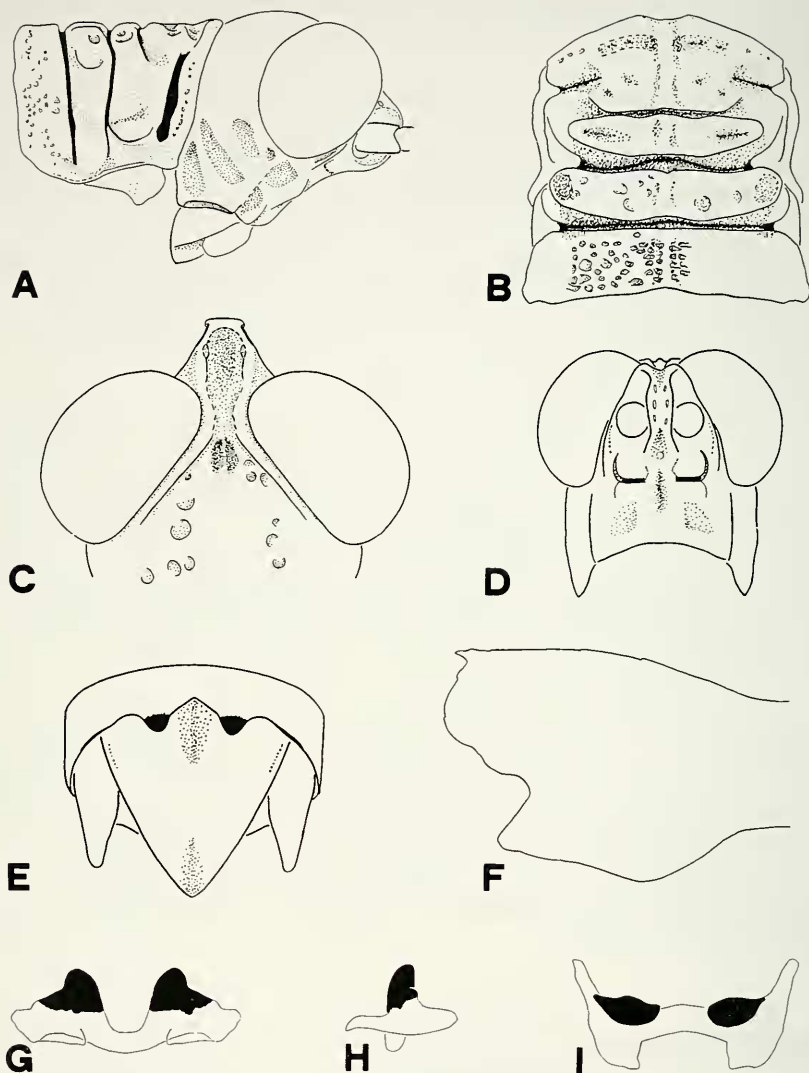


FIG. 9

*Scirtopaon dorsatus* Descamps & Rowell, 1984. Male. A, lateral view of head and pronotum. B, dorsal view of pronotum. C, dorsal view of head. D, frontal view of face. E, dorsal view of furcula, supraanal plate and cerci. F, lateral view of hind knee. G-I, epiphallus; G axial view, H, lateral view, I, dorsal view (The original description additionally figures the whole male, the male furcula and supraanal plate, the female fastigium and metanotum in dorsal view, and the female ovipositor valves in lateral view).

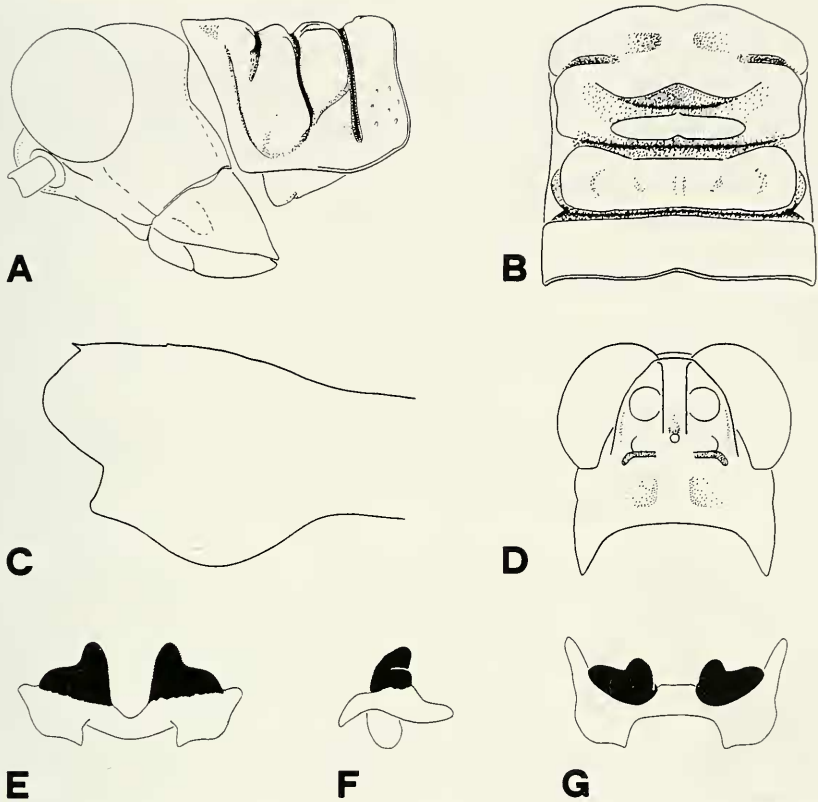


FIG. 10

*Micropaon lucens* Descamps & Rowell, 1984. Male. A, lateral view of head and pronotum. B, dorsal view of pronotum. C, lateral view of hind knee. D, frontal view of face. E-G, epiphallus; E, axial view, F, lateral view, G, dorsal view. (The original description additionally figures the whole male, the male furcula and supraanal plate, the female fastigium in dorsal view, and the female ovipositor valves in lateral view).

***Micropaon lucens* Descamps & Rowell, 1984**

(Fig. 10)

The genus is well differentiated morphologically by the flat fastigium without grooves or ridges (Fig. 10D), the smooth, ungrooved frontal ridge (Fig. 10D), the short rounded rostrum, the thickened margin to the posterior margins of the meso- and metanotum, and the single medial black spot on the male supraanal plate. *Micropaon lucens* is a very local species of the Pacific slopes of the Talamanca range, so far known from only a few localities, all lying within a 3 km square on the hills above S. Isidro del General. It is found in marshes or where water seeps out of the ground, characteristically where *Polygonum* (Polygonaceae) and *Galinsoga* (Asteraceae) grow, though it does not appear to eat either of these plants. Its normal diet is unknown.

## DISCUSSION

The Rhytidochrotinae is known as a very homogeneous group, and this holds for the six Costa Rican genera, which all comply to a basic morphological plan and are distinguished from each by rather small differences, as judged by the standards within other acridid subfamilies. Especially the uniformity of the male genitalia of the Rhytidochrotinae is unusual within the Acrididae, though the present work has shown that the male epiphallus offers some taxonomic possibilities (true also of the South American taxa examined). In spite of their formal similarities and the isolated geographic position of the Costa Rican taxa, it is not easy to speculate convincingly about their interrelationships. Only *Scirtopaon* and *Brakeracris* appear to share some possibly derived characters which may indicate a recent common ancestry. The other genera appear quite distinct from these two and from each other.

It is perhaps necessary to stress that despite formal morphological similarities, the Costa Rican rhytidochrotines have clearly different ecological requirements, very different colour patterns and usually do not overlap in distribution. They present no difficulties at all in field determination, it is merely the technical separation which is harder.

The Rhytidochrotinae, with its small number of taxa and interesting present day distribution (see also DESCAMPS & AMÉDÉGNATO 1972b) would be an interesting group for an independent study of phylogeny based on genomic sequence data. To date no rhytidochrotines are known from Central America north of Costa Rica (*Exerythracris*, extending to near the Nicaraguan border, is the most northerly known representative of the subfamily) and the only known Panamanian genus (*Piezops*) comes from the extreme South of that country near the Colombian border. All the remaining Central American rhytidochrotines are confined to Costa Rica. It is quite possible that some of the apparent isolation of the Costa Rican rhytidochrotines is an artifact of inadequate collecting or relatively recent human destruction of the habitat, particularly in Northern Panama. However, as all the Costa Rican rhytidochrotines are montane forms, it is equally possible that the lowlands of central and southern Panama are indeed a natural barrier to dispersal, at least under the present climatic conditions. The last Ice Age must have diminished this barrier very considerably, and the presence of numerous Andean elements on the páramos of the Talamanca Range of Costa Rica (see WEBER 1958, and for other acridological consequences, ROWELL & CARBONELL 1977) indicates that many organisms were able to disperse between these two habitats in the past, possibly including the rhytidochrotines. The *Puya/Blechnum* swamps of the Talamanca are a striking example, and *Talamancaacris* (unless it might be discovered in the equivalent Andean habitats) would seem to be a relict taxon with a remarkably small range and population size and potentially extremely vulnerable to extinction by habitat alteration.

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